

"Gatekeepers of knowledge" within industrial districts: who they are, how they interact

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Gatekeepers of knowledge within industrial districts:
Who they are, how they interact

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Abstract

Recent studies on industrial districts suggest that their innovative performance is strictly linked to their ability to absorb external knowledge. Yet, the existing literature provides few insights into the functioning of this process. This paper, focusing on leader firms located in a successful Italian furniture district, investigates whether they feed the district with knowledge absorbed from external sources, thereby behaving as *gatekeepers of knowledge*. Findings show that leader firms are well connected with knowledge sources; yet, linkages with districts firms are far more limited as are informal exchanges, which, when they do occur, are mostly restricted to generic information

Keywords: Knowledge flows; Industrial districts; Leader firms; Community of technicians; Furniture industry; Murge region.

JEL classifications: B52, L14, O18, Z13.

1. Introduction

Many empirical studies indicate that the innovative performance of industrial districts is strictly linked with their ability to absorb external knowledgeⁱⁱ. The main line of reasoning behind this is that industrial districts combine external codified knowledge with local tacit knowledge. A ‘translating’ mechanism seems to be at work within the district, which makes scientific knowledge produced outside the local area understandable to its members (BECATTINI and RULLANI, 1996). The new pieces of knowledge generated by this conversion process become part of the district’s competitive assets.

However, it is not clear how these learning and knowledge diffusion processes develop. A large part of the literature seems to take it for granted that industrial districts are able *per se* to translate and share external knowledge, which raises concerns about the robustness and plausibility of the theoretical conclusions based on this approach and the implications for policy. In sum, the literature rather overlooks some of the key issues concerning the specific mechanisms and actors through which learning and knowledge diffusion occur within districtsⁱⁱⁱ.

The aim of this paper is to identify and analyse the main actors and flows involved in these conversion processes. Our main goal is to assess to what extent district members access and share external knowledge and to analyse whether the distinction between ‘local-tacit’ and ‘external-codified’ knowledge is important in this context.

The theoretical framework draws on the concept of *gatekeepers of knowledge* (ALLEN, 1977), which provides useful insights into the processes of learning and knowledge diffusion. We apply this analytical tool to investigate a well-known industrial district located in a region in the south of Italy, the Murge furniture district (VIESTI, 2000a). In particular, we examine to what extent the leaders in the district behave as “gatekeepers of knowledge”. The analysis is based on a selected sample of leader enterprises and organisations. In depth semi-structured interviews target a cohort of technicians and managers working in knowledge intensive units in selected leader firms. After

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identifying the critical stages of the design and production processes, we focus on the web of ties in which these key activities are ‘embedded’ in order to get a detailed picture of the main information and knowledge flows circulating within and between leader firms and organisations located outside the district.

In line with several recent contributions that have emphasised the role of leader firms in shaping districts learning processes (ALBINO *et al.*, 1998; BOSCHMA and LAMBOOY, 2002; LAZERSON and LORENZONI, 1999; LISSONI, 2001), this study finds that leading firms devote significant efforts to search and translate knowledge coming from external sources, including universities and sectoral research centres. Yet, it also finds that informal contacts are far less pervasive than suggested by conventional approaches to industrial districts. Indeed, when these contacts are in place, they mainly serve to exchange generic information rather than know-how.

The paper is structured as follows. In section 2 we briefly discuss the recent empirical contributions on knowledge diffusion in industrial districts. Section 3 presents a conceptual framework for analysing the role of leading firms in fostering knowledge diffusion at district level. Section 4 provides a short history of the Murge sofa district and its main organisational features. Section 5 describes the methodology and the sample. Section 6 discusses the empirical results on firms' knowledge activities and the network analysis. Section 7 concludes with some policy implications.

2. Leading firms and knowledge diffusion in industrial districts: the main issues

The focus of long debate on industrial districts and clustering has recently shifted to knowledge related issues (BOSCHMA, 2005; BRESCHI and MALERBA, 2001; MALBERG and MASKELL, 2002). Both scholars and policy makers have strongly supported the idea that “a large share of market-based or informal knowledge flows occurs within industrial clusters that can be seen as reduced-form innovation systems”. [Accordingly], “policies to stimulate innovation at national and

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3 local levels must both build on and contribute to the dynamics of innovative clusters” (OECD,
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5 1999).

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8 Underlying this idea is that firms located in industrial districts share common values, rules and
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10 languages; in other words they form a cohesive social environment (BECATTINI, 1990;
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12 SAXENIAN, 1994). Social, cultural or organisational proximity, along with spatial closeness,
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14 enable knowledge to circulate freely among local actors, (CAPELLO and FAGGIAN, 2005;
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16 FREEL, 2002; MALMBERG and MASKELL, 1999; RALLET and TORRE, 2005). In this context,
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18 informal contacts (i.e. *face to face* interactions) have been regarded as key vehicles for the
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20 transmission of knowledge and information (AUDRETSCH and FELDMAN, 1996; FELDMAN,
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22 1999; SAXENIAN, 1994). A complementary argument is that firms outside the district cannot
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24 access the local 'tacit' knowledge (BECATTINI and RULLANI, 1996), since they are physically
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26 and culturally distant (i.e. lack of common codes); firms that want to benefit from these externalities
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28 must relocate into the district.
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34 Although many scholars would agree with this reasoning, there are some that would disagree
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36 about the assumptions and implications behind it. One criticism would be in terms of the well-
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38 established view that conceives industrial districts as undifferentiated communities of small firms.
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40 There is some support for this criticism in recent empirical evidence on Italian industrial districts,
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42 which shows how individual entrepreneurial strategies have significantly shaped their take-off and
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44 development (ALBINO *et al.* 1998; BELLANDI, 2001; GRASSI and PAGNI, 1999; LAZERSON
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46 and LORENZONI, 1999; VIESTI, 1995; 2000a). For instance, the appearance of leading firms
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48 seems to have strongly affected the internal organisational structure of industrial districts in terms
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50 of how they compete, cooperate and access external inputs and markets (BELUSSI *et al.* 2003;
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52 BOSCHMA and LOMBOOY, 2002; CORÒ and GRANDINETTI, 1999; VIESTI, 2000b). Recent
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54 evidence shows that leaders are better endowed in terms of technology and exhibit a higher
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56 propensity to invest with respect to other small and micro firms in districts area. They have been
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58 able to build stronger capabilities and consequently to access a larger set of external information
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and knowledge sources. Therefore, leaders would allow districts areas to avoid lock-in effects, and in turn to face the increasing international competition.

A further and related criticism has been put forward by the literature on innovation. They suggest that the research agenda should shift from the measurement of unintentional local knowledge spillovers to knowledge flows, which would allow researchers to clearly identify the amount and the nature of the knowledge shared among local actors (BRESCHI and LISSONI, 2001a and b). Underlying this view is the idea that the tacit-codified distinction is misleading in explaining how knowledge is exchanged in geographical bounded communities, such as industrial districts, because, for instance, it does not help to identify which portions of the local technical knowledge are appropriated by each actor (BATHELT *et al.*, 2004; COWAN *et al.* , 2000; LISSONI, 2001).

A similar concern has been also raised by some economic geographers, which have provided more detailed measures of collective learning processes (CAPELLO and FAGGIAN, 2005; MAGGIONI and RIGGI, 2002) and a more comprehensive conceptualisation of individual and collective learning activities in districts like areas (BOSCHMA and FRENKEN; 2006; CAMAGNI and CAPELLO, 2002; MALMBERG and MASKELL, 2002).

Overall, these criticisms suggest that industrial districts should be considered as networks of heterogeneous agents, and that knowledge should be viewed as a personal and specific asset (NELSON and WINTER, 1982; POLANYI, 1962). In such a context, firms' strategies and competences matter greatly, and are regarded as relevant for explaining a district's dynamism. These approaches convey the idea that knowledge, rather than circulating freely, is constrained within small epistemic communities (STEINMUELLER, 2000), which are characterised by multiple-level networks (GIULIANI and BELL, 2005; LISSONI and PAGANI, 2003; MORRISON and RABELLOTTI, 2005).

This paper contributes to the latter body of literature by proposing an original framework to analyse the mechanisms of knowledge acquisition in industrial districts. Although the literature has recognised the necessity of investigating the sources and flows of knowledge at local level, very

few studies have addressed this topic. In addition greater insight is needed for somewhat neglected role of leading firms as providers of external knowledge for the district.

3 The emergence of knowledge gatekeepers in industrial districts: an analytical framework

In this section we outline a conceptual framework within which to explain the role of leading firms in the process of knowledge adoption and diffusion within industrial districts. We conceive knowledge diffusion as an interactive learning process in which exchanges occur within formal and informal channels. The analytical background draws on the concept of *gatekeepers of knowledge* (ALLEN, 1977). In Allen's terms gatekeepers have the following features^{iv}:

- they constitute a small community of individuals;
- they are at the core of an information network;
- they are overexposed to external sources of information;
- their linkages with external actors are mostly informal.

In addition, "gatekeepers can understand at least a portion of the material published in the refereed journals and can then translate this information into terms that the average technologists can use" (ALLEN, 1977: 148), which implies that these actors also perform a 'transcoding' function for those (other actors within the organisation) who cannot interact with external sources of knowledge (which, in Allen's example, are refereed journals). Gatekeepers first identify external sources, and then interpret and absorb the information and ultimately translate it so that it becomes meaningful for colleagues (TUSHMAN and KATZ, 1980). This requires a high level of absorptive capacity and in addition a high level of relational capital, which implies that they have to be well connected to both internal and external information sources through a variety of either formal or informal channels, thereby acting as boundary spanners (GITTELMAN and KOGUT, 2003; TUSHMAN, 1977; TUSHMAN and SCANLAN, 1981).

The concept of gatekeeper, as discussed above, provides us with a powerful analytical tool to investigate the role of leader firms in absorbing, using and diffusing knowledge at cluster level. To

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a certain extent the two levels of analysis (i.e. firm vs. cluster) have some similarities. In both cases, there is a small population of actors (i.e. researchers in firms/labs vs. leading firms in clusters) that are capable of interpreting external messages. Again, in both cases, these actors are at the core of large networks (i.e. communities of researchers in the former and networks of providers and clients in the latter). However, there are also some important differences. Although leading firms may have the capabilities needed to identify external sources and acquire knowledge from them (as researchers in Allen's example do for their laboratories), they may not have the 'willingness' to share it with other district members. Moreover, the cognitive distance between leaders and other actors (e.g. district firms; organisations) can hinder knowledge transmission, independently from the leaders 'willingness'. Hence, we argue that leader firms can be considered to be gatekeeper if they perform both a searching, and a 'transcoding' and a sharing function. These functions can be defined as follows:

- The *searching* activity is the ability to capture external sources of knowledge which appear to be relevant to the firm;
- The *transcoding* function is related to the firm's ability to *translate* and to make meaningful complex knowledge to its internal units;
- The *sharing* function is the ability to disseminate in-house accumulated knowledge to district members, either through personal and informal mechanisms, or through business relations and collaborations based on formal agreements.

The *searching* and the *transcoding* (or translating) functions are strictly related to *absorptive capacity*^v. The firm's research expenditure, which represents the stock of prior accumulated knowledge, is a crucial factor for identifying different knowledge fields and capturing and identifying those inputs that are needed for the firm's innovative activity. At the organisational level, '*searching*' means that firms look outside their boundaries to seek for complementary inputs. In our context, this means that firms look outside the district's borders to search for information sources. All these activities require purposeful effort and investment. In fact learning is not an easy

and straightforward task, on the contrary it is subject to both cognitive and organisational limitations (NELSON and WINTER, 1982). Firms experiment alternative organisational forms (e.g. departmentalisation of the organisational structure; tight *versus* loose coupling of internal departments; creation of inventories of competences) to overcome these difficulties and with the aim at effectively organising their experience; in short they attempt at enhancing learning. However, in doing, so they can paradoxically produce further impediments to the learning process itself (HANSEN, 1999; LEVINTHAL and MARCH 1993). Learning traps are particularly relevant in searching activities outside firm boundaries. Effective *searching* requires a differentiated set of internal competencies (i.e. relative absorptive capacity; relational capabilities), besides R&D investment, which serve to mitigate the distance - in terms of knowledge bases, but also in terms of organisational structure- between the targeted source of knowledge and the firm (LANE and LUBATKIN, 1998). These competencies are conventionally developed and structured in formal departments, although in more traditional low-tech sectors (e.g. wood, furniture, leather products, shoes) they can also be developed through informal mechanisms (MANGEMATIN and NESTA, 1999; VINDING, 2006).

The *transcoding* function needs some further clarifications in a district context. Firms performing the *transcoding* function use their internal routines and tacit skills to translate external knowledge into firm-specific know-how (CAMAGNI, 1991), which is a complex task, since knowledge replication and transfer are subject to barriers that limit its diffusion (SZULANSKI, 1996). At district level firms have to understand different coding schemes, i.e. those of the external knowledge sources and those of the potential district recipients (i.e. other firms within the same district). District firms may operate in different jargons, have different organisational routines and knowledge bases, leading firms must be familiar with all of these aspects to perform their translation task. Thus knowledge is often sticky (SZULANSKI, 2000, VON HIPPEL, 1994), and codification skills and mutual understanding (i.e. trust) are both necessary to make more fluid its transfer; in other words effective communication entails both physical and relational-specific

investment, these latter highly needed to avoid knowledge leakages (ARGOTE and INGRAM, 2000; DYER and HATCH, 2006). This means that firms involved in *transcoding* activities will be able and willing to share their knowledge with a limited number of internal (to the district) actors. These will most likely be those firms with whom the transcoder has a relatively well established relationship. The lower the complexity of the knowledge, the lower the skills required to appropriate it, and correspondingly the lower the costs of codification. In general, costs play a key role in firms decision to undertake a codification activity; as Nelson and Winter pointed out the issue is not “whether a particular bit of knowledge is in principle articulable or necessarily tacit (...). Rather, the question is whether the cost (...) are sufficiently high so that the knowledge in fact remain tacit” (1982: 80). The advancement in information technology has further accelerated and facilitated these processes (COWAN *et al.* 2000; STEINMUELLER, 2000), though, as recently argued by some scholars, there are still some domains of knowledge (e.g. know-who, know-how) for which standardisation and codification are not feasible, or at least rather difficult, since they involve a lot of social and contextual elements (JOHNSON *et al.* 2002: 251,252).

In terms of the *sharing* function, we need also to consider the incentives that people working in leading firms’ face when cooperating with local actors, which mainly depends on the expected benefit (i.e. rents) from trading (CARTER, 1989; von HIPPEL, 1987). The relationship among local actors can be interpreted as a mutual exchange, but in fact generally this relationship is reciprocal i.e. those that receive a benefit will make a return in the future (SCHRADER, 1991). This condition is a prerequisite for establishing an interaction and feeding it. People want to establish useful linkages, that is, relationships with those actors able to return meaningful knowledge. When exchanges occur between firms with different stocks of knowledge, or different abilities to access one another’s stocks of knowledge, i.e. when these relationships are asymmetric, one of the partners, most commonly the powerful one, may be reluctant to share its knowledge. In our context, assuming that leader firms are the most powerful (in terms of the in-house accumulated knowledge stock or the opportunity and ability to access valuable sources), they may be unwilling to share with

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3 small firms, regarding them as unable to reciprocate with useful knowledge. Equally, they may be
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5 unwilling to share knowledge with other leaders, since they may be afraid of ideas being
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7 appropriated.
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10 Besides, knowledge transmission can be inhibited because of the cognitive distance
11 (BOSCHMA, 2005). The effectiveness of the interaction is limited by the fact that the receiver
12 cannot fully exploit the knowledge provided by the source, either because its competences are too
13 distant or too little as compared to those of the source. Similarly, if the cognitive distance is too
14 small, the knowledge bases of the exchangers may overlap, thus the interaction becomes useless for
15 both (BATHELT *et al.*, 2004). Conversely, when the distribution of knowledge assets is more
16 balanced, therefore the knowledge bases of firms are neither too dissimilar nor too close,
17 interactions between peers are more likely to occur and in turn to contribute to the collective
18 enhancement of their knowledge bases.
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31 Thus, in the circumstances in which knowledge sharing takes place, it is interesting to check
32 whether this is limited to 'small ideas' (i.e. generic information), or it rather entails more
33 widespread process of knowledge socialisation. In other words, when a specific network structure
34 emerges within a cluster, such as a leader centred-network, this may strongly influence what is
35 shared among its members (i.e. knowledge vs information).
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46 4. The case of the Murge sofa district: some essential features

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48 Altamura, Santeramo and Matera constitute the three vertices of the *sofa triangle*, a
49 circumscribed geographical area spanning the regions of Puglia and Basilicata. The district has
50 experienced an exponential growth in the last few decades, becoming the main sofa producer region
51 in Europe and achieving the world leadership in leather sofas. Employment steadily rose from less
52 than a thousand employees in the fifties up to more than six thousands (VIESTI, 2000b: 105). These
53 figures represent 9,2% of the employment in the furniture sector in Italy, and more that 50% of the
54 employment in the furniture sector in the South of Italy (VIESTI, 2000b: 104). The population
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counts almost two hundred firms^{vi}, which cover almost the entire production value chain (with the exception of machines, tannery and wood): 50% of them are engaged in the production of sofa, the remaining are either subcontractors (38% of the total) or providers of components (12% of the total) (e.g. textile, leather, standard components). The business is family based, with several individual firms and rather high birth and death rates, due to the very low entry barriers. In more recent times, (since 2002) however, the district has been seriously affected by the Asian competition, which has forced many producers out of business, and several others to relocate their production facilities abroad.

District's main features are strictly related to the story of its main firms and their founders: Mr Natuzzi, Mr Calia and Mr Nicoletti. In particular, Mr. Natuzzi had a pioneering role in the district's take off (BELUSSI and BERTINI, 1998; MOLINARI, 1994; VIESTI, 2000a). His early steps in the sofa industry go back to the end of sixties, when he established the first factory. The firm quickly became an exporter and participant in major international fairs (e.g. the Frankfurt furniture fair). Although his first attempts to penetrate the European market were unsuccessful, he was not discouraged, and turned to the US market. At the beginning of the eighties he signed his first important deal with the large retail group, Macy's^{vii}. Since then, Natuzzi Ltd. experienced rapid growth and has become a multi-divisional group with a large and diversified product strategy. Currently the group exports to 123 countries and owns factories on three continents: Europe (Italy, Eastern European countries), Asia (China) and South America (Brazil). In a few years it had developed a franchising network of 150 galleries and more than 100 shops around the world. Although, like many other district firms, Natuzzi has experienced a major slowdown in the most recent years, in 2002 the Natuzzi group's sales reached almost €800millions (over 50% of the Murge districts' sales). The firm relies on several subcontractors and providers, with which it has rather stable and exclusive relations, although more recently has started to vertically integrate the production process. The Calia and Nicoletti companies are the most important representative of the medium sized companies in the district, each with sales of €80 millions in 2002. The founders of

these two companies started off working together at the end of sixties, but soon went their separate ways, giving rise to two independent companies. From the outset their strategy was to produce high-quality sofas supported by efficient customer service. This also affects their organisational structure; in particular Calia is highly vertically integrated. Like Natuzzi, both firms export nearly 80% of their production. Nicoletti is applying for listing on the Italian stock exchange and is planning to develop a franchising network for its sofas. Along with many other firms in the district they have offshore production activities, mostly in Romania. In recent years both firms have had good sales performance (+50% Nicoletti; +134% Calia between 1999 and 2002). Before discussing the empirical results, we need to highlight how the sofa industry, and the Murge district, have evolved since the 1980s, and particularly:

- The Murge district has grown exponentially since the early 1990s, and most firms are involved in several international markets. Information flows have grown accordingly, which has forced producers to set up distant networks in order to access, collect and store all these data.
- A rapid and deep industrialisation process has characterised the industry and in particular this district. These changes pushed firms increasingly to seek for specialised external services related to engineering and organisational issues.
- The incremental nature of the innovation process and the intensive product diversification (some firms produce more than a thousand models) has meant a continuous search for new sources of ideas and partners that can add value to products (e.g. designers).

5. Sample and methodology of analysis

5.1 Sampling criteria and data collection

The first step of the research design consisted in identifying the set of leaders relevant for the analysis. The selection was based on the review of the already available literature on this production system. All the empirical studies carried out on this industrial district agree in that Natuzzi and

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Calia Ltd^{viii} are the dominant actors^{ix} (ALBINO *et al.* 1998; ALBINO *et al.* 2001; BACULO, 1994; BELUSSI and BERTINI, 1998; MOLINARI, 1994, SCHIUMA, 2000; VIESTI, 2000a and b). In order to further check this evidence, we also conducted a number of interviews to local key informants (e.g. expert scholars at local universities; representatives of local business associations and trade unions), which corroborated this view. The selected firms account for almost 80% of the district's turnover and contribute to a widespread network of subcontractors, which in many cases were spin-offs of the leader firms. They are a major influence on subcontractors in various respects, for example they require specific standards in terms of quality or time delivery. These leaders have played a key role in the take-off of the district, and more importantly it has been argued that they greatly contributed to the local learning dynamism, in particular by connecting the local production system with external sources of information and knowledge (ALBINO *et al.* 1998; VIESTI, 2000b).

Data were collected during two fieldworks in 2001 and 2002. The first one was mainly devoted to conduct pilot interviews, which allowed to select the sample, and to carry out the analysis at leader firms, which entailed several in-depth interviews to chief executives and technical staff employed at the knowledge intensive units (for more details see section 5.2). The functional areas investigated were Production, Marketing, Engineering, R&D, Quality control, and Prototyping. Experts working in these units were further asked to complete a structured questionnaire concerning their external relations, in particular those aimed at exchanging information and knowledge with firms and organisations (for more details see section 5.3). Experts mostly corresponded to the department head, or to the person responsible for the specific function and were selected with the guidance of informants among those employees in the unit that were recognised to be the best informed about the broad range of activities and relations the department has developed.

The second field-work served to gather information about firms and organisations that experts reported to have contacted^x. The final sample includes 26 district firms and 26 organisations. Interviews to both firms and organisations were aimed at collecting general and contextual information about their activity and relations, and to validate the information provided by the

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3 technicians working for leaders. We limited our analysis to firms located in the geographical area of
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5 the district, which is delimited by the towns of Altamura, Santeramo in Colle, and Matera. This
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7 sample mainly consists of sofa manufacturers; but also some specialised providers of components
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9 and few large sofa subcontractors. The organisations include local universities, certification
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11 laboratories, entrepreneurial associations and other knowledge organisations.
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15 The above research design provided material to explore the following issues: (1) the intra-firm
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17 and inter-firm knowledge production and diffusion processes; (2) the typology of actors (e.g. firms,
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19 organisations) and relations (formal; informal) involved and the nature (i.e. information;
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21 knowledge) of flows transmitted through them; (3) the role of informal contacts in channelling
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23 knowledge from leaders to the local community of technicians. We deal with these issues below.
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29 5.2 Methodology: the searching and transcoding and sharing functions

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31 In order to analyse the role of the leading firms in identifying, absorbing and diffusing
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33 innovation-related knowledge, we examined the different phases encompassing the design, project
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35 and production processes of the sofa. This analysis was based on detailed reproduction, including
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37 charts and diagrams, of the leader firms' shop-floors^{xi}. This material was collected through
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39 extensive interviews with entrepreneurs, executive managers and technicians at the knowledge
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41 intensive units of the leaders. The aim of this exercise was twofold. On the one side it served to
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43 identify the key nodes (internal and external) of the innovation process developed by leaders, and to
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45 map their knowledge system. On the other side, it revealed the complexity and key features of the
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47 knowledge activities developed within firms; in particular it shed light on the codification efforts
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49 carried out by the leaders. In addition, it helped to distinguish the many different features of flows
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51 connecting the internal and the external actors (e.g. input, decision, knowledge, formal, informal).
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53 In this respect, it is worth mentioning that our attention was mainly devoted to relationships that
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55 arise from firm-level activities that entail the production of innovation-related knowledge. In doing
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57 so, we privileged an inductive rather than deductive method of inquiry. This means that the set of
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linkages analysed was not defined *a priori*; on the contrary, intra-firm and inter-firm relationships depicted in Figure 1 were identified through the on-the-field investigation. The analysis encompasses a wide range of different relationships: from untraded relationships to more formal ones; from exchanges of commodities to research collaborations; from personal interactions to observation of competitors.

The information and material gathered through this exercise enabled the second part of our analysis, namely the network analysis.

5.3 Methodology: sharing via informal contacts and acquisition from knowledge sources

The acquisition and diffusion of knowledge and information was also investigated using sociometric techniques (WASSERMAN and FAUST, 1994).^{xii} In line with recent studies that have empirically mapped knowledge networks in districts like contexts (BOSCHMA and TER WAL; 2006; GIULIANI, 2006; GIULIANI and BELL, 2005; MORRISON and RABELLOTTI, 2005), we focused on informal contacts between technicians. This channel has been in fact widely acknowledged by both economists (ASHEIM, 1996; AUDRESTCH and FELDMAN, 1996; CAMAGNI, 1991; CARTER, 1991; SAXENIAN, 1994; VON HIPPEL, 1987) and scholars of social networks (BURT, 1992; GRANOVETTER, 1973; HANSEN *et al.*, 2001; ROGERS, 1995) as a key mechanism for know-how sharing. We also examined interactions developed by leaders with knowledge sources (universities, business; associations; etc). In order to trace these linkages, expert technicians at the knowledge intensive units of the leader firms (i.e. Calia and Natuzzi) were asked to indicate whether they had informal conversations with colleagues in other district firms or if they had collaborated with organisations. Relational data were collected through structured questionnaires based on an open roster method^{xiii}: each respondent (i.e. key technicians of leading firms) had to personally check and then mark the firms and organisations she/he interacted with from a list including the sample of firms and organisations^{xiv} More important, we asked technicians to specify whether conversations and collaborations concerned technical advice (i.e. *know-how*)^{xv} or

exchange of generic information (i.e. declarative knowledge)^{xvi}. These questions specifically aimed at distinguishing between communities that emerge as result of informal chit-chat - for example those allowing technicians to be informed about employment opportunities - from those that entail a learning process. These latter communities originate from interactions of technicians that purposefully search peers in order to solve some complex problem, give advices, or suggest innovative solutions. The competences required for such a task are firm-specific, and in this sense these exchanges are regarded as transfers of contextual (i.e. tacit) knowledge. It is worth stressing here that this is the kind of idiosyncratic knowledge that according to the literature is transferred through face-to-face interactions.

In line with conventional social network methodology, we can graphically visualise these relations. We consider two nodes (i.e. firm units) to be connected if there is any tie between them. In our case we recognise a linkage between a unit of a leading firm if the interviewed expert of that unit reported having established an informal contact with some other firm(s) or having interacted with an organisation(s) in the population. More in details, the information network has been represented by an undirected graph, since its underlying relations are symmetrical; whereas the knowledge network has been represented by a directed graph, as it is based on asymmetrical relations. Following standard sociometric techniques the degree centrality index^{xvii} has been computed for both information and knowledge networks. In particular for knowledge networks we computed the in-degree centrality index (i.e. the number of in-going ties, named degree of *absorption*), which measures the leaders' engagement with knowledge intensive organisations, and the out-degree centrality index (i.e. the number of out-going ties from leaders' departments to other district firms, named degree of *openness*), which captures the propensity of the community of experts to share knowledge locally.

There are some limitations in this analysis. First, the network includes only direct ties that connect leaders units to other district firms. Thus, we might have underestimated the role of information flows in the network as whole. Yet, as far as knowledge flows are concerned, this

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should not be a major problem, since, as shown by the literature (AHUJA, 2000), direct ties enable knowledge transfer, while indirect ties seem to be more likely to convey information. In addition, due to the nature and amount of relational data available for this study, we could not apply more sophisticated social network analysis techniques and indicators.

To conclude, the analysis of the leaders' networks complements the qualitative investigation of leaders' knowledge activities, and provides additional evidence on informal contacts and on linkages with knowledge sources.

6. Empirical analysis and results^{xviii}

6.1 'Searching' and 'sharing' with external sources of knowledge: a purposeful effort

In this section we identify internal and external actors involved in *searching* and *sharing* activities. From chart 1 and 2 in Figure 1, it appears that leading firms are able to access a considerable number of sources of information (e.g. agents, designers, clients). Agents, the 'Tempi and Metodi' unit and the design centre emerge as the key actors in the firms' searching activities.

We start our reconstruction with the external actors. Agents are one of the main information sources for leaders. They represent the firm's interests around the world and take care of the largest clients (e.g. main retailer groups). They provide information on both commercial (e.g. market trends) and technical issues (e.g. products faults). They are the recipients of the larger clients' claims and requirements, which can suggest changes to a product line (e.g. colour-covers combinations). Yet, in a very few cases clients' requests provoke radical modifications, indeed producers are reluctant to implement suggestions that might involve costly changes at shop-floor level. These conflicts are often sort out with minor interventions, which incorporate clients' main claims.

Agents report to the firms' headquarters on regular basis and the firms make special effort to maintain regular communication with them as these actors constitute their main gateway to distant markets. To facilitate this communication some of the leaders (e.g. Natuzzi) have developed an

intranet system which allows them to be connected in real time with their worldwide agent network. The sales units are responsible for this function. The internal network serves to either receive data or provide agents with information (e.g. related to new product characteristics). The firm's sales office answers agents' requests either directly or forwards specific questions to appropriate units (see chart 3, Fig.1, top right). Apart from formal communication devices (e.g. e-mail; intranet), information also flows through personal contacts. Clients frequently visit firm factories. These visits provide opportunities for informal meetings that are crucial events that allow producers to listen and respond to clients' requirements and suggestions. Executive management encourages these visits, especially during the preparation of a new catalogue to be presented at an international fair. The knowledge exchanges described so far can be mainly referred to as *formal* or *informal* knowledge flows, although in both cases they involve codified or codifiable knowledge. *Formal* knowledge flows correspond to fully codified knowledge with manifest codebook, for example technical specifications of previous models, which have been stored in a database, and retrieved by technicians, as those used by the diagnostic group (triangle in chart 3, Fig.1, top right); but they include also codified knowledge with displaced codebook (i.e. not manifest) (COWAN *et al.*, 2000), as in the case of the above informal conversations. *Informal* flows correspond to codifiable knowledge, as the one exchanged in the codification process of leather-cutting operators practices (see next section). To be noticed that informal conversations, as those between clients and firm representatives, do not necessarily imply the access to firm-specific knowledge. In fact, although both parties may share some common background, their interactions are affected by their specific competences (e.g. clients or machine providers may or not operate in the specific sector or be competent in the specific knowledge domain of their counterparts in the firm), which can either increase or reduce their cognitive proximity, and by the specific appropriability strategies of sofa manufacturers, which might try to limit clients' (or providers) access to the firm-specific knowledge. This latter aspect crucially depends on the strategic relevance of the external actor: for example 'test' customers are those that operate in key markets for the firm, therefore the firm

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maintains closer relations with them, which are based on mutual recognition and exchange of information.

In terms of the internal actors, the leading firms dedicate specific resources (e.g. designers, architects) to regular monitoring of market novelties (e.g. new materials, new machines, new testing procedure) through, for example, systematic review of specialist magazines, or through monitoring of rivals' models during fairs. Natuzzi has set up two units to conduct research on product and process innovations: the 'Centro Stile' (design centre) and the 'Tempi and Metodi' (R&D) unit. The former involves designers and architects working exclusively for the firm. They maintain contact with external designers and clients through formal relationship established by the executive management. Informal relationships based on personal contacts are not common. The R&D unit monitors the whole production process, checking especially for bottlenecks in the production process, and provide solutions to any problems that are detected. Not infrequently, technicians working in this unit contact local and international research centres in order to sort out problems. Recently, this unit has been increasingly devoted to experimenting with new production methods and equipment in order to speed up the sofa production cycle (more details in the next section).

What the analysis has shown so far is that the leaders carefully and purposefully screen the external environment for information sources and new ideas, rather than relying on unintentional local observation and informal chit-chats. Moreover, this searching is not limited to the local area, rather it involves geographically dispersed actors. In the following next subsections we discuss the transmission mechanisms and the content of input exchanges.

Figure 1

6.2 'Translating' knowledge: internal and external actors involved in codification activities

The need to deal with a large number of knowledge flows forced firms to think carefully about the optimum level of knowledge codification. In some cases heavy investments in ICT technologies

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3 were undertaken to manage and store information at every step of the production process. In other
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5 cases major efforts were concentrated on the elaboration of a completely new coding scheme. Other
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7 cases resisted to a full codification. Overall, codification enabled faster communication with
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9 external sources (e.g. agents, subcontractors) and increased the leading firms' control over
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11 information flows by avoiding, for example, information leakages in communications with
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13 subcontractors and key input providers. Some of the key nodes are illustrated in the Figure 1.
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17 We start our analysis from the initial idea for a new model (see chart 1, Fig. 1). This takes place
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19 in the internal design unit (i.e. Design Centre), where architects and designers sort out ideas and
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21 examine suggestions from major customers, agents and external designers, but also observing
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23 models of rivals in magazines and at fairs. Architects within this unit recombine external inputs
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25 following the firm's guidelines. The executive managers, and often the entrepreneur himself, can
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27 define and transmit a draft project to the design unit, including instructions about the design
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29 parameters and target price. A first evaluation meeting is held to decide whether the drawings
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31 submitted by the design centre match these criteria (see chart 1, Fig. 1, bottom centre). The
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33 entrepreneur often plays a key role in the selection process based on his deep understanding of the
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35 design and production processes gleaned through working as upholsterer or a background in design
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37 or architecture. This evaluation process is not straightforward; drawings often have to be modified
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39 several times before they are approved. In the past, this procedure was extremely time consuming,
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41 since it was based on paper drawings; however, new computer-based technologies allow for virtual
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43 prototyping. Thus changes to the first draft project can be introduced quickly, and, since simulations
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45 can be run many times, many different scenarios can be studied before the physical prototype is
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47 assembled. The product development team can execute virtual experiments and test the sofa under
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49 many different conditions. This process does not require specific (i.e. tacit) knowledge and the
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51 simulation can be implemented by an ICT technician (not necessarily expert in the sector), and at
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53 almost no cost, relative to the old prototyping activity. This shows how knowledge codification and
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re-combination activities (NONAKA and TAKEUCHI, 1995), through the introduction of ICT tools, facilitate learning processes and, simultaneously, speed up the innovation process.

During the prototyping activity, product managers, designers and prototypers, have to achieve a consensual view of the project. It may be that the product manager has a conservative attitude towards the designers' proposals. He may resist the approval of designs that would entail considerable changes in the organisation of the production process. A consensus is generally reached through a bargaining process (generally informal), in which the prototypers, who have knowledge about both the design and production sides, find out a suitable compromise between the somewhat conservative attitude of managers vs. the more progressive one of designers. The technical specifications and drawings involved in the evaluation are stored in a database (see chart 2, Fig.1, middle right). It should be noted that in both these activities, bargaining and storing, there is a socialisation of knowledge among the actors involved. The difference between the two stems from the mean of transmission: it is informal - no written charts or documents appear- during the 'bargaining' process, but is highly formalised during the 'storing' process.

The prototype, as well as its constituent parts (e.g. covers, frames) are produced and assembled in the prototype unit. Each prototype is required to pass through several stages. The first step consists of testing the sofa's aesthetic features. This evaluation involves both internal units and external actors (e.g. agents, clients, designers). The external evaluation is carried out by selected 'test customers', who might be agents from strategic markets or large retailers. Test customers may suggest minor changes to the model; however it is the internal evaluation meeting that has the final word in approving the design. Executive managers, product managers, the prototyper and designers are all involved in the 'Internal Evaluation' meeting (known as the 'comfort examination', see chart 2, Fig.1, middle centre). During this meeting, the decision to go ahead or abandon the project is taken. At this stage, the prototyper is the central actor. He has direct knowledge about the components, the reliability of who provides critical inputs and about the technical specifications of any previous model. Hence, he can rapidly suggest adaptations to overcome problems and also

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3 rapidly find who can fix specific faults or defects, the *know-who* type of knowledge that is a mix of
4 information and social relationships (JOHNSON, *et al.* 2002). Going back to the tacit-codified
5 controversy; it can be argued, that the prototyper experience represents the kind of knowledge that
6 the firm cannot make explicit.
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13 Once the prototype model is ready, a technical test is carried out^{xix}. External service centres carry
14 out certain tests (often those needed for international quality certification). Information concerning
15 testing activities is stored in a dedicated database. This type of information is important; if technical
16 specifications on past models and components are needed – for example, because a new model
17 incorporates components already tested and adopted previously, technicians can easily retrieve the
18 data. This kind of knowledge, which was previously incorporated in the experience of individual
19 technicians (e.g. prototypers), has been codified and made available to other shop-floor workers and
20 executive managers, who are usually not familiar with it.
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32 Although the idea of the sofa has been translated into a physical artefact (i.e. the prototype), it is
33 still not ready to enter the manufacturing process. First, the engineering unit must decompose the
34 sofa into its different components and schedule their production. The time schedule is then sent to
35 the technical office, which collects and reproduces it along with other technical data organised in
36 technical charts. These technical charts are sent (via the intranet network) to the machine operators
37 and external subcontractors (see charts 2 and 3, Fig. 1).
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46 The engineering unit, along with the 'Tempi and Metodi' unit, are the main gates for accessing
47 external information and knowledge about process innovations. In particular, since the mid 1980s,
48 these units have been extremely active in reducing the firm's dependence on critical inputs (in
49 particular leather cutting operators). Both Natuzzi and Calia have made huge efforts to codify the
50 experience (i.e. tacit knowledge) of highly-skilled workers. This has been translated into best
51 practice, which has been reproduced in manuals, or has been substituted for by automated
52 machines. These activities have been often developed with the close collaboration of external
53 consultants and especially with machine producers^{xx}. These codification efforts have been
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particularly successful, in those few firms, like Natuzzi, which, because of their economies of scale, could afford the investment. This example shows that tacitness is not an absolute feature of knowledge, but is related to cost issues and firm incentives (NELSON and WINTER, 1982).

Next the prototype undergoes a further evaluation, the so called ‘approval before production’ procedure (see chart 3, Fig.1, top left). Here the knowledge is socialised in informal meetings (i.e. the diagnostic group), although the procedure itself is highly standardised. The diagnostic group, which involves several different units (see chart 3, Fig.1, top right), looks at the problems that may arise when the new model enters the manufacturing process. It draws on the accumulated experience of different units (i.e. mainly tacit knowledge) and also benefits from the flow of information from agents, for example faults that have been reported by final customers. Following this, various inputs (e.g. covers, frames), decisions (e.g. the approval of a the prototype) and information (e.g. technical charts) flows converge and the model is approved for production. If any problems arise at this stage, a ‘problem solving action’ is jointly implemented by the quality and engineering units; the problem may be one of a bottleneck, resulting from unexpected product faults or unjustified time delays in the production trial (see chart 3, Fig.1, bottom right). This is again a highly standardised procedure, although carried out in an informal way (mostly through short meetings). Once any problems on the shop floor have been fixed, other actions can be taken. For example, special training courses might be arranged for workers, or formal instruction manuals may be thought necessary in case similar problems arise in the future.

To conclude, we have shown that several different flows can be generated during the design, project and production processes. They appear to be mostly informal (not written down) and exchanged in informal locations (e.g. corridors or short unplanned meetings), although some formal meetings do take place. The prevailing wisdom would consider these flows to be *tacit* knowledge (in the sense that they are somewhat idiosyncratic and transferred through informal means). However, we claim that often this is not so. Firms have strong incentives for, and accordingly put strong efforts into, codifying knowledge (e.g. producing manuals, defining standardised procedures,

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3 introducing simulation technologies, etc). The knowledge remains tacit in a few cases either
4 because codifying it would be too costly (for example the ‘approval procedure’, or the skills of the
5 cutting machine operators) or because it is impossible to make it explicit (for example the
6 experience of prototypers).
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12 13 14 15 6.3 Intra-district knowledge sharing through informal contacts 16

17 According to the evidence so far, several different kinds of flows (e.g. knowledge, information,
18 decision, materials) circulate *within* and *between* firms. These flows either concern technical advice
19 (i.e. know how) or generic information (e.g. about customers, providers, market trends, employment
20 opportunities). The analysis shows there are a number of internal actors that participate in those
21 exchanges as well as external sources of information and knowledge for firms. In this section we
22 further explore the nature of these linkages, in particular we intend to assess whether leaders
23 internal units are able to convey both information and knowledge and the extent to which their
24 action is limited within the boundaries of the firm, or conversely cross the firm borders. As pointed
25 out in section 4.3, we focus on a specific transmission mechanism, i.e. knowledge socialisation
26 through informal contacts, which has been acknowledged by the literature as a key channel through
27 which knowledge circulate in geographical bounded communities. In this context, the network
28 analysis helps to visualise linkages and to shed light on the different roles actors play in the local
29 knowledge system.
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48 The structural characteristics of the two networks examined are sketched in Figures 2 and 3,
49 which clearly indicate that knowledge intensive departments in each leader firm develop different
50 relations according to the content of the exchange (i.e. information, knowledge). In particular,
51 information sharing is rather diffused, whereas know-how exchanges are limited to few actors. The
52 figures also show that the two leaders centred communities have established very few, or no
53 linkages between them. Moreover, we also observe clear distinctive behaviours as far as *openness* is
54 concerned, which is particularly interesting, since it points to the existence of heterogeneous
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conducts, contrasting with the conventional view of districts as homogenous communities: on the one hand, Calia's units are characterised by a strong propensity to interact with other district's firms, while Natuzzi's units develop very few external relations, on the other hand.

Although we do not have systematic data on that, several key respondents, in particular interviews conducted with former designers at Natuzzi, suggested that these differences can be ascribed to the climate of distrust diffused in the Natuzzi company, with respect to the more cooperative one observed at Calia. The top management of Natuzzi has been described by respondents as particularly concerned about the risks of leakages of the firm-specific knowledge held by some employees (e.g. designers), which are now subject to explicit non-disclosure agreements, as well as exclusivity rules have been implemented also with providers of critical inputs. Thus, all these actions might have discouraged employees to establish new informal contacts or nurture the existing ones.

Figure 2

Figure 3

The information in the above figures is presented in tabular form in Table 1. Firstly, the degree of *openness* concerning information exchanges is 4,05 – that is, each unit is directly linked with other four firms in the district- while for knowledge exchange it is only 1,13. In addition, several units of the knowledge network are cognitively isolated.

Table 1

6.4 Absorbing knowledge from knowledge sources

In this section we assess to what extent leaders establish contacts with sources of knowledge and in particular with research centres, laboratories, sectoral associations and universities. The main network features are depicted in Figures 4 and 5. As in the previous section, we compare two cases: contacts involving information exchanges (see also Fig. 4) and those involving knowledge

exchanges (Fig. 5). Overall, results suggest that leaders' departments are fairly well connected with knowledge institutions. Science parks and universities are among the most contacted organisations (see Tab. 4). Thus, both networks are quite dense, although, as expected, information exchanges are more spread than knowledge exchanges. Indeed, as can be seen from Table 2, the information network includes all the institutions and units in the population (a part from two), whereas in the knowledge network four units are cognitively isolated.

Figure 4

Figure 5

Furthermore, it should be noted that the degree of absorption observed in these networks (i.e. extra-district networks) is equal or even higher than that for intra-district networks, and that as far as knowledge exchanges are concerned, the maximum number of contacts in the extra-district network is eight, three more than the five observed for the intra-district network (see Table 1 and Table 2).

Table 2

Table 3 shows further interesting features of the networks. We observe that R&D and Quality units are those with the highest degree of *absorption*. Thus, technicians working in key units (in terms of the knowledge they cumulate) appear to be willing to contact researchers and technicians in organisations. However, they are much more cautious when interacting with people from other firms (as shows in columns 5 and 6 in Table 3). In relation to the cognitive distance between these actors (i.e. R&D units of leaders and organisations), Figure 5 shows that the R&D units of both leader firms are well connected with both types of knowledge producers, i.e. universities, and knowledge service centres, though the latter are the most frequently contacted.

Further on the difference between the two leaders, we notice that their networks differ greatly in terms of geographical reach. In particular Natuzzi's technicians present several connections with international actors, as compared to Calia. At least two main reasons can be considered for this.

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Firstly, the difference can be ascribed to the market segments in which the two firms operate. Natuzzi is prevalently active in the low-middle market segment, where competition is harsher and profit margins lower than in the top-end market where Calia operates. Therefore Natuzzi, more than Calia, has strongly invested to reduce production costs. This has been done by carrying out internal R&D to develop organisational and process innovation that could speed up the production process, but also searching for external collaborations that could help in fastening the development of these solutions. Secondly, it is worth noting that large part of these differences in international contacts is due to collaborations with certification labs (see also section 6.2). This is partly related to the fact that Natuzzi prevalently exports to countries adopting strict safety regulations (e.g. California). Thus the internal quality and R&D units developed close relationships with labs located in the market of destination as to acquire competences.

Table 3

Yet, in general the most contacted organisations are located near to the leaders. Table 4 shows a detailed framework. The majority of interactions take place with actors located close by; the *University of Bari*, the *Tecnopolis* science park, also located in the Bari province, and the *University of Basilicata*, located in the bordering province of Matera are well interconnected with leaders while foreign or national organisations appear to be far less well connected.

Table 4

7. Conclusion

A well established literature maintains that the greater innovative dynamism of industrial districts resides in their ability to integrate external codified knowledge absorbed from distant actors with local tacit one, and to disseminate it to their members (BECATTINI and RULLANI, 1996).

The underlying idea is that being knowledge in districts prevalently tacit, translation and socialisation processes require close proximity and personal relationships, coupled with the ensuing argument that informal conversations are key mechanisms for know-how transmission (SAXENIAN, 1994) and that these interactions occur in a rather unstructured, unplanned and unintentional way (MALBERG, 2003). Therefore in districts like contexts, knowledge is conceived as local public good, at disposal of the large community of entrepreneurs and technicians located within the local area, which accrues its benefits almost by chance and with little or no effort. However, in this account little is known about the differential capabilities of firms to absorb knowledge and on the efforts they have to sustain in order to use and eventually share it with locals, or more importantly to appropriate it. In short, the translation and socialisation processes appear to be rather automatic mechanisms, a sort of black box, in which firms individual strategies disappear (LAZERSON and LORENZONI, 1999). This paper aims at shedding lights on the role of individual firms in contributing to learning activities at local level in the Italian Murge furniture district; it investigates in particular the extent to which leader firms feed the local area with knowledge absorbed from external sources, thereby acting as *knowledge gatekeepers*. We address the complexity of knowledge production and diffusion mechanisms underlying the gatekeeper functions, by carrying out a detailed firm-level analysis of the functions and relations involved in these processes. We show that leaders adopt well defined strategies and undertake considerable investment for implementing both the ‘translation’ and codification functions. Rather than being unstructured, interactions with external actors are developed and maintained by specific departments inside leaders. In addition, we show that dedicated investments are planned and carried out by firms to simplify, codify or transmit a vast amount of information and knowledge flows. As far as the tacit-codified debate is concerned, our findings show that costs and firm market position are the key factors driving leaders’ decision to undertake codification processes. Therefore tacitness is a relative, rather than absolute feature of knowledge, subject to the actors’ specific incentives that determine the extent to which a certain bit of knowledge is codified.

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Moreover, the detailed reproduction of the workflow allowed for the identification of the nature and content of the relationships contributing to firms’ production and innovation activities. These relationships encompass both informal and formal collaborations, which can vehicle both codified and tacit knowledge. From our findings, the community of informal ties appears to be rather small and *know how* sharing is also rather limited, suggesting that knowledge from leaders does not circulate pervasively among all district members. The latter is consistent with recent studies arguing that knowledge is a ‘club good’, which tends to be selectively appropriated by district’s firms (BRESCHI and LISSONI, 2001; GIULIANI, 2006; LISSONI, 2001). At the same time, our findings provide further evidence that leading firms play a central role in shaping industrial districts, not only because they are at the centre of subcontracting networks, but also because leaders are at the core of multiple level networks of information and knowledge.

Yet, our conclusion is more cautious about the positive role leading firms may play in sustaining the innovative dynamism of industrial districts. Indeed, our findings suggest that on the one side leading firms act as a filter for the local knowledge system, since they screen and select external knowledge sources and accordingly guarantee the quality content of the knowledge transferred to their local partners. On the other side, though, the stronger position accrued by leaders in the knowledge network might increase the vulnerability of the knowledge network, as it makes its development dependent upon the strategy of few dominant actors. This potential conflict rises interesting and open questions over the prevailing scenarios and how these could be sort out (see for example BECATTINI, 1998, on the role of public actors). This has important implications in terms of policy support to leaders and its effectiveness. For example, measures aimed at building infrastructures for knowledge diffusion between large and small firms in clusters may be substitutive rather than additional (GEORGHIU and ROESSNER, 2000). Indeed, they may overlook the linkages put in place by the already existing informal ties in the communities of technicians (LISSONI, 2001), having the ensuing effect of lowering the likelihood of further interactions and consequently of learning opportunities for local firms. A better targeting of policy

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3 intervention, instead may tend to balance the power between leaders and other districts firms, which
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5 would allow for endogenous smoothing of potential conflicts and increasing of cohesion in the
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7 district.
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10 Yet, conclusions from this study should be taken with cautious as the analysis is not exempted
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12 from specific limitations. First, the Murge district is a paradigmatic example of a concentrated
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14 district revolving around its main leaders, which has been heavily dependent upon their fortune
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16 since the origins till its most recent evolution. Therefore, lessons can be drawn from this
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18 experience, but cannot be abruptly transposed to other districts, even to those that present a leader-
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20 centred structure. We may observe more spread knowledge networks and even more diffused
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22 information ones in industrial districts characterised by higher homogeneity, where the asymmetry
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24 of power is less pronounced and the cognitive distance between clustered firms lower (GIULIANI,
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26 2006). Moreover, our results may suffer from a bias, as the analysis is mainly focused on the
27
28 relationships and actors involved in knowledge production and diffusion activities at firm level.
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30 Yet, other important channels (e.g. labour mobility; observation of competitors) and dimensions
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32 (e.g. financial) may be considered for future research (BAHTLET *et al* 2004; MALBERG and
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34 MASKELL, 2002).
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41 A second limitation of this analysis concerns the scarcity of data. The nature and amount of
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43 relational data available for this study allowed to provide insights into the main structural
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45 differences between knowledge and information leaders' networks; however little can be said on the
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47 specific configuration of their structures, whether for example they assume either a core-periphery
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49 configuration (BORGATTI and EVERETT, 1999), a highly dense structure or instead present
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51 structural holes (BURT, 1992; COLEMAN, 1988). Owning this information would be useful to
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53 address a number of related questions concerning for example the effect of different network
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55 structures (e.g. dense vs dispersed) on firms performance (AHUJA, 2000) or the extent to which
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57 they convey simple or complex knowledge (HANSEN, 1999). Similarly, it would be interesting to
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59 learn more about the geographical dimension of knowledge diffusion in districts like contexts and
60

how this is linked to the social proximity of actors (MAGGIONI and UBERTI, 2007; PACI and BATTETA, 2003).

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Table 1
The intra-district networks of leader firms: structural indicators

	Information exchanges	Knowledge exchanges
Average degree of openness	4,05	1,13
Isolated firms	8	19
Isolated units of leaders	3	4
Max n. of connections	15	5

Table 2

The leaders' networks with organisations: structural indicators

	Information exchanges	Knowledge exchanges
Average degree of absorption	3,83	1,56
Isolated depts. of leaders	2	4
Isolated organisations	7	0
Max n. of connections	12	8

Table 3

The knowledge intensive units of leader firms: information and knowledge exchanges

			Information exchanges		Knowledge exchanges	
Node	Firm units		with other	with	degree of	degree of
			district firms	organisations	absorption ¹	openness ²
Natuzzi	N.1	Production Area	2	4	1	2
	N.2	Input Area	0	9	2	0
	N.3	Prototype Area	0	2	0	0
	N.4	Quality Area	0	10	5	0
	N.5	R&D Area	2	12	8	3
Calia	C.1	Prototype Area	15	0	0	3
	C.2	Marketing Area	13	8	1	4
	C.3	Production Area	15	8	0	0
	C.4	Input Area	13	0	0	4
	C.5	Quality Area	13	9	8	4
	C.6	R&D Area	2	9	4	2

(1) Linkages between leaders units and organisations. (2) Linkages between leaders units and other district firms.

Table 4

The centrality of the sources of knowledge

Node	Name	Core activity	Location	Number of contacts	
				Information exchanges	Knowledge exchanges
O.1	Basentech	Scientific Park	Region ⁺	4	2
O.2	Cetma	Service centre	Region	4	0
O.3	Tecnopolis	Scientific Park	Region	8	1
O.4	Bic (Ceii System)	Service centre	Region	3	0
O.5	Centro Enea Trisaia	Research centre	Region	4	0
O.6	Catas	Sectoral service centre	Italy	5	4
O.7	Legnolegno (Forlì)	Sectoral services	Italy	1	0
O.8	Clac (Centro Legno Arredo Cantù)	Sectoral services	Italy	1	0
O.9	Adi	Sectoral association	Italy	1	0
O.10	Università Bari	University	Region	7	4
O.11	Università Basilicata	University	Region	6	2
O.12	Unione Industriali	Industrial syndicate	Region	5	2
O.13	Camera di Commercio	Service centre	Region	5	1
O.14	Icec	Certification centre	Italy	2	1
	Stazione				
O.15	Sperimentale Pelli - Napoli	Research centre & services	Italy	2	1
O.16	Istituto Breda – Bari	Research centre & services	Region	2	0

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O.17	Sda Bocconi	Training	Italy	1	1
O.18	Lapi	Research centre & labs	Italy	1	1
O.19	Centrotessile Cotoniero	Research centre & labs	Italy	1	1
O.20	Fira International	Research centre & sectoral services	International	2	2
O.21	Università di Bologna	University	Italy	1	1
O.22	Ufac	Research centre & sectoral services	International	1	1
O.23	Tno	Research centre & sectoral services	International	1	1
O.24	Uni-CERT-	Certification lab.	Italy	1	1
O.25	Iso-CERT-	Certification lab.	Italy	1	1
O.26	Bvqi-CERT-	Certification lab.	International	1	1

+Region: Puglia or Basilicata;

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Figure 1 Leaders' work-flow
Chart 1: design

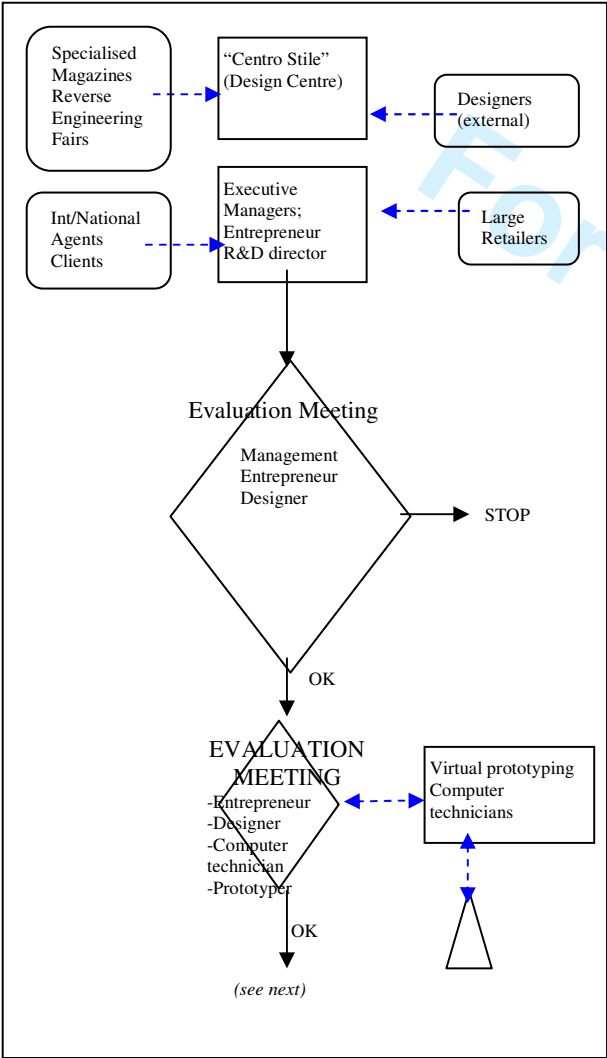


Chart 2: project

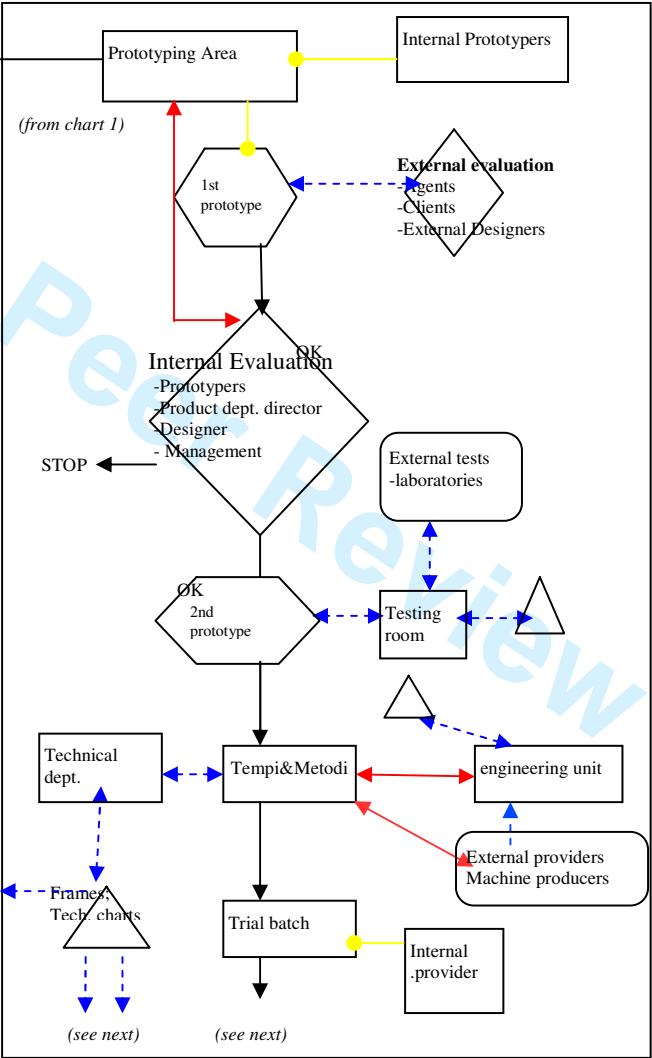


Chart 3: production

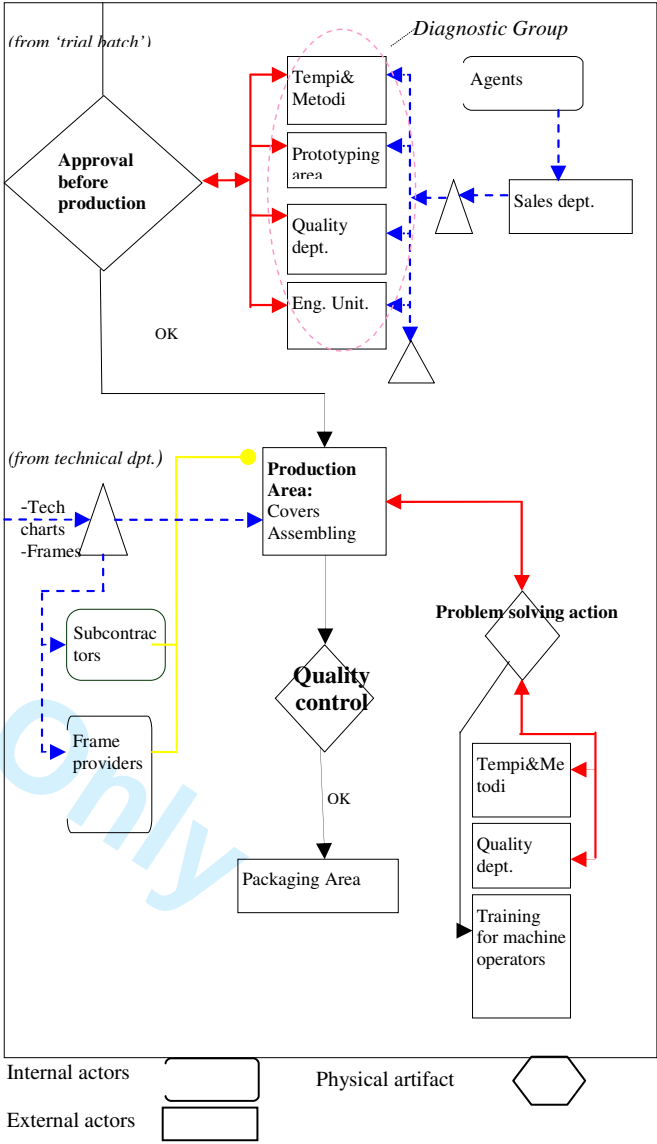


Figure 2 The information network

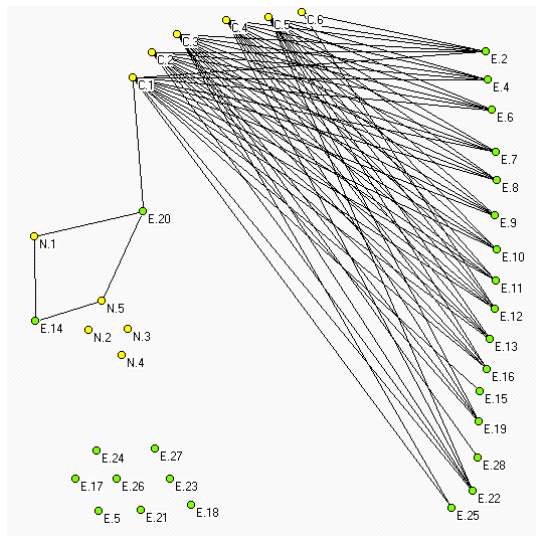
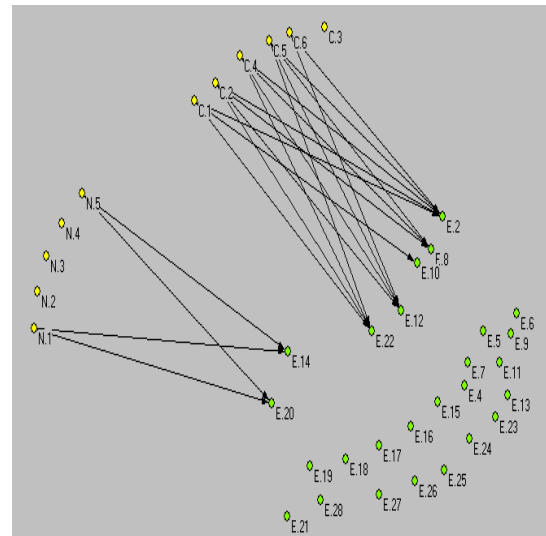


Figure 3 The knowledge network



“N” stands for Natuzzi departments “C” for Calia departments. “E” points identify technicians of the other district firms.

Figure 4 The information network

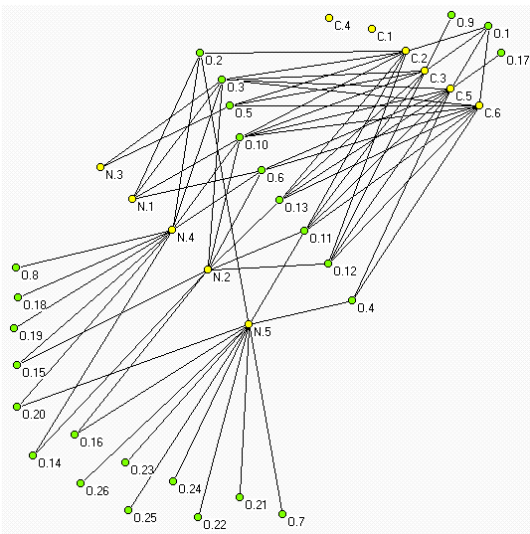
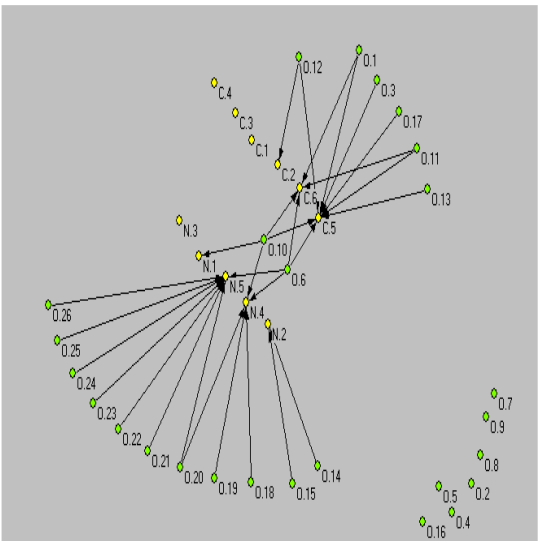


Figure 5 The knowledge network



“N” stands for Natuzzi departments and “C” stands for Calia departments; “O” points identify organisations.

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ⁱⁱ Approaches from different perspective have focused on the relation between space and knowledge (e.g. neo-marshallian industrial districts, *innovative milieux*, localised knowledge spill-over, geography of innovations, economics of innovation and firms). Part of this debate can be found in recent articles published in *Regional Studies*, 1999, vol.33 (4); *Cambridge Journal of Economics*, 1999, Vol.23 (2) and *Industrial and Corporate Change*, 2001, vol.10 (4); *Regional Studies*, 2005 vol.39 (1).

ⁱⁱⁱ Scholars in regional studies and economic geography have increasingly acknowledge that colocalisation in industrial districts is not sufficient to explain the spatial diffusion of knowledge. A pioneering approach is that elaborated by the Gremi school (see Camagni , 1991). For more recent contributions see Boschma (2005) and Boschma and Frenken (2006).

^{iv} According to Allen (1977: 145), gatekeepers are “a small number of key people to whom others frequently turned for information. These key people differed from their colleagues in the degree to which they exposed themselves to sources of technological information outside their organisation” .

^v In Cohen and Levinthal words defined as the ‘firms’ ability to identify, assimilate and exploit knowledge from the environment (1989: 569).

^{vi} Other areas in the Puglia region have attracted several other furniture firms in the last ten years.

^{vii} He based his success on low prices: the company's first leather sofa sold for \$699 against an average US price of \$1999.

^{viii} Nicoletti Ltd. is also regarded a key actor by the literature; however it was ultimately excluded because it refused to participate to the survey.

^{ix} Prof. Viesti, one of the main expert of this district, states: “Pasquale Natuzzi (the founder of the Natuzzi company) has played a key role in the take off of the sofa district” and he further adds “Without Natuzzi it would have been very unlikely to see the birth of the district” (2000b: 137, our translation).

^x Part of these data have been used in another author's paper to investigate the innovative performance of districts firms (MORRISON, 2006).

^{xi} We mainly refer to the Natuzzi company. Natuzzi's production process is rather more complex than other medium and small sized firms in the district. Nevertheless, the company is a useful and interesting case since it encompasses all the possible actors, knowledge and information flows produced by a leader firm.

^{xii} For a full description of measures and indicators see WASSERMAN and FAUST (1994).

^{xiii} Respondents marked the firm in the list with which they had a contact. They could also add further contacts that did not appear in the list.

^{xiv} The initial list included firms located in the district area. These firms were extracted from the Aida database (ATECO class 36.11.2-sofas). Organisations were selected based on suggestions of key informants and respondents.

^{xv} For contacts with organisations the question was formulated as follows: *"Which of the following organisations have contributed to solve technical problems or provided relevant knowledge to your firm/department (see list)?"*

For contacts with firms the question was formulated as follows: *" In your day to day work, which of the following firms (owners or technicians employed in these firms; see list) do turn to you to obtain technical advice?"*

^{xvi} For contacts with organisations the question was formulated as follows: *"Did you exchange information (e.g. about new business opportunities; new sellers or providers; availability of inputs; machinery or technology performance and features; regulations) with researchers/employees of the following organisations (see list)?"*

For contacts with firms the question was formulated as follows: *"Did you have any informal contacts with employees - or the owners- of the following firms (see list) in order to exchange information (e.g. about new business opportunities; new sellers or providers; availability of inputs; machinery or technology performance and features)".*

^{xvii} This indicator measures the number of nodes to which each node is directly connected. The higher the degree, the more actors access the knowledge: $C_D(n_i) = d_i(n_i)$ where d_i identifies the number of lines incident to it (FREEMAN, 1979).

^{xviii} This section is partly based on the author's doctoral thesis (MORRISON, 2004).

^{xix} Natuzzi, for example, set up an internal test room to run most of the technical tests on the sofa and its components. This is why he collaborated with several laboratories, as shown in section 6.4.

^{xx} The most interesting example concerns the leather-cutting machines. In this case workers' skills were reproduced and transposed into software installed in hydro and laser cutting machines, which were adapted from those used in the tile industry. The design and development required the close collaboration of technicians from several fields (e.g. computer

programming, electronics, mechanics, leather and textile). See ALBINO *et al.* (2001) and SCHIUMA (2000) for a detailed analysis.

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